The Neural Network analysis for the single cell of Molten Carbonate Fuel cell (MCFC)

S. K. Dhakad[1],S.C.soni [2],Pankaj Agrawal[3] ,Prashant Baredaer [4]

[1]MED, SATI (deg), Vidisha, M.P., [2]Ex director MANIT Bhopal M.P. India,
[3]MED, SATI, Vidisha M.P. India, [4]Energy Deptt. MANIT Bhopal M.P. India
sk27_dhakad@yahho.com, drscsoni@gmail.com, dr_pankajagrwal@rediffmail.com, India,prashant_baredar@yahoo.com

Abstract:

In the present work try to trained the performance and evolution for the single cell of the MCFC by using the Neural Network tool in the MAT-Lab software. The data used for the Neural Network training are, simulated results, these are obtained for the single cell of the MCFC [1].The analysis carried out for n input vectors (known input variables i.e. temperature and load current) and power as output vector. Figure 2 shown simulated powers at the different values of input variables, as load current & temperature. Figures 3 shown the trained results are obtained using model in the form of approximate feed forward neural network for the 4 layers & 2:3:2 neurons. Power as the output vector of the MCFC is well compare to the simulated results shown in figure 5.

Keywords: Simulation, MCFC, Feed forward Neural network, power of cell, model practical utility.

1. Introduction:

In the MCFC research objective area difficult to modeling analysis due to the complicated characteristics such as nonlinearness, uncertainty and

the time changes. The MCFC modeling based on artificial neural networks is advanced [2]. Feedforward networks consist of a series of layers. The first layer has a connection from the network input. Each subsequent layer has a connection from the previous layer. The final layer produces the network's output.

Feedforward networks can be used for any kind of input to output mapping. A feedforward network with one hidden layer and enough neurons in the hidden layers can fit any finite input-output mapping problem. Neural networks are algorithms for optimization and learning based loosely on concepts inspired by research into the nature of the brain [3].
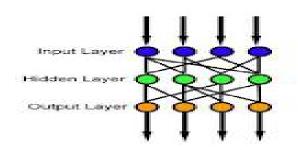

Fig1 Shown Simple neural network

2. Methodology:

The collected data are arrange as n in put variables (i.e. temperature , pressure ,current.etc) and one output such as Voltage/ Power. Then feedforward Neural network model with given numbers of layers with given numbers of neurons in each layer is defined. Then the neural network trained for the input data for given number of epochs. Now get the approximate model of fuel cell in the term of neural network. The trained NN validated by calculating the outputs of training input vectors. The process is repeated until the, error is then the required criteria. Trained model used for cell performance estimations.

3. Simulated power of single cell of MCFC:

In the figure 2 shown simulated powers at the different values of input variables, as load current & temperature, using develop mathematical model of MCFC [1].
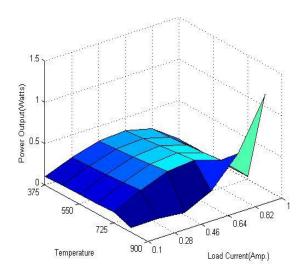

Figure 2 Shown Simulated/Optimized powers at the different values of input variables, as load current & Temperature of the cell.

4. FFNN model trained for the Simulated power:

Using the proposed methodology describe in the section 3, approximate feedforwared neural network (FFNN) model trained for the 4 layers & 2:3:2 neurons. In the training n input vectors (input variables as temperature, load current), and one output vector as power is considered. Trained results are shown in the figure
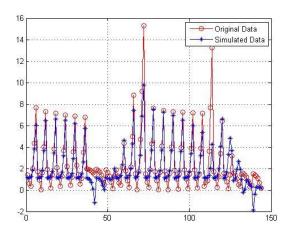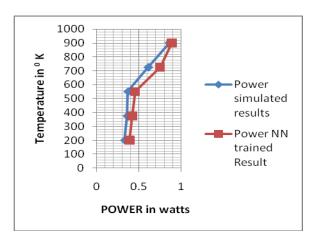

Figure 3 Shown the Neural network trained results (4 layers, 2:3:2 neurons)

5 FFNN trained power of the single cell of the MCFC:

In the figure 4 shown the compression in the power using mathematical model of the single cell of the MCFC and FFNN trained model.

Figures: 4 Shown the comparative power variation of the single cell of the MCFC cell

Conclusion:

The numbers of limitations in the develop of Mathematical model of MCFC (larger verities in equations and input/ output boundary conditions). The practical utility/application are the important factor for any developed mathematical model. In the present analysis only power predicted .In the further research work, present analysis will be apply entire variables used in developed mathematical model.

References:

[1] S.K. Dhakad, Dr.S.C. Soni, et.al. "Mathematical Modeling and Performance Simulation and Optimization of Molten Carbonate Fuel Cell (MCFCs), International Journal of Engineering Research and Industrial Application, p.p. Vol.5, No.3, August 2012 p.p. 299-311.

[2] Josto and Pablo canizares etal. "The neural networks based modeling of a polybenzimidazole-based polymer electrolyte membrane fuel cell: Effect of temperature"

Journal of Power Sources Volume 192, Issue 1, 1 July 2009, Pages 190–194 CONAPPICE 2008, Zaragoza, Spain, 24-26 September 2008.

[3] D.Whitley, "Applying Genetic Algorithms to Neural Network Problems" International Neural Net" work Society p. 230 (1988).

[4] Training Feed forward Neural Networks Using Genetic Algorithms David J. Montana and Lawrence Davis B B N Systems and Technologies Corp.10 Mouiton St. Cambridge, MA 02138 pp 762-767 .

[5] Arbib, Michael A. (Ed.) (1995). The Handbook of Brain Theory and Neural Networks.

[6]Hadzibeganovic, Tarik & Cannas, Sergio A. (2009). "A Tsallis' statistics based neural network model for novel word learning".Physica A: Statistical Mechanics and its Applications 388 (5): 732–746.

[7] Steeb, W-H (2008). The Nonlinear Workbook: Chaos, Fractals, Neural Networks, Genetic Algorithms, 4th edition. World Scientific Publishing. ISBN 981-281-852-9.

[8] J. Koh, B. Kang, H.C. Limet al. "Effect of various stack parameters on temperature rise in molten carbonate fuel cell stack operation" Journal Power Sources, 91 (2000), pp.161– 171.

[9] Sung-Yoon Lee, Do-Hyung Kim, Hee-Chun Lim, et al. "Mathematical modeling of a molten carbonate fuel cell (MCFC) stack" International Journal of Hydrogen Energy, Volume 35, Issue 23, December 2010, Pages 13096–13103.

[10] W. He, Q. Chen,"Three-dimensional simulation of a molten carbonate fuelcell stack under transient conditions"Journal Power Sources, 73 (1998), pp. 182–192.